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(71) Applicant
Process Improvements Limited

(Incorporated in the United Kingdom)

Glendale Park, Fernbank Road, Ascot, Berkshire, SL5 8BJ, United Kingdom

(72) Inventors
David Charles Richards
Maurice Stanley Williams
Brian Ward

(74) Agent and/or Address for Service
Hughes Clark Byrne & Parker
63 Lincoln's Inn Fields, London, WC2A 3JU, United Kingdom

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(52) UK CL (Edition K)
B8C CF1 CU42
B8T TSHB

(56) Documents cited
GB 1468499 A **GB 1345445 A** **GB 1273969 A**
GB 1056322 A

(58) Field of search
UK CL (Edition K) **A2B BAFC BAFDC, B8C CF1**
INT CL[5] **A22C, B65B**

(54) Apparatus for producing axially compacted tubing

(57) An annular container 20 mounted at the base of a passage between a layering tube 15 and a central mandrel 6 is charged with flexible tubing 22 delivered over a floating mandrel (5) when coaxially in contact with mandrel 6 by driving rollers 32 coacting with pinch rollers 48 on the floating mandrel 5. The tubing passes over the mandrel 6 and gathers in the layering tube 5 while being compacted by two sets of shoes 4, 4a reciprocated 180° out of phase by rotating discs (53, 53a) and connecting rods. When sufficient tubing has been delivered, the floating mandrel is raised to enable a hot wire to pass between the mandrels to sever the tubing 22. The layering tube 15 and central mandrel 6 with the container 20 can then be carried by a turntable 21 through further stationary positions where the layered tubing is further compressed by reciprocable rings (Figs 9, 10), a lid is put on the container 20 to form a cassette and the cassette is discharged. The lid may be snap-fastened passed internal preformed container wall tabs or the tabs may be pierced out of the container wall whilst the lid is pressed down on the compacted tubing (Figs 15-17).

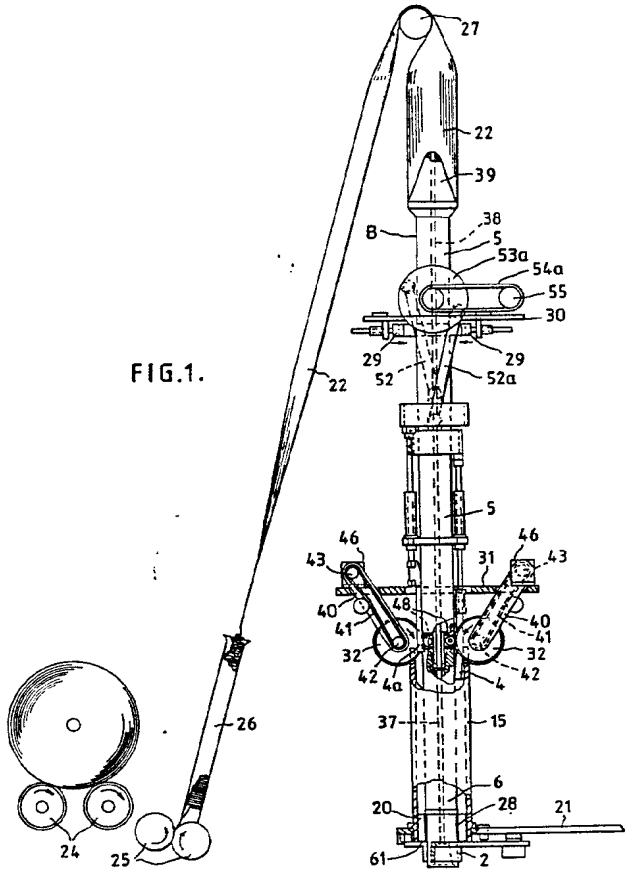

FIG.1.

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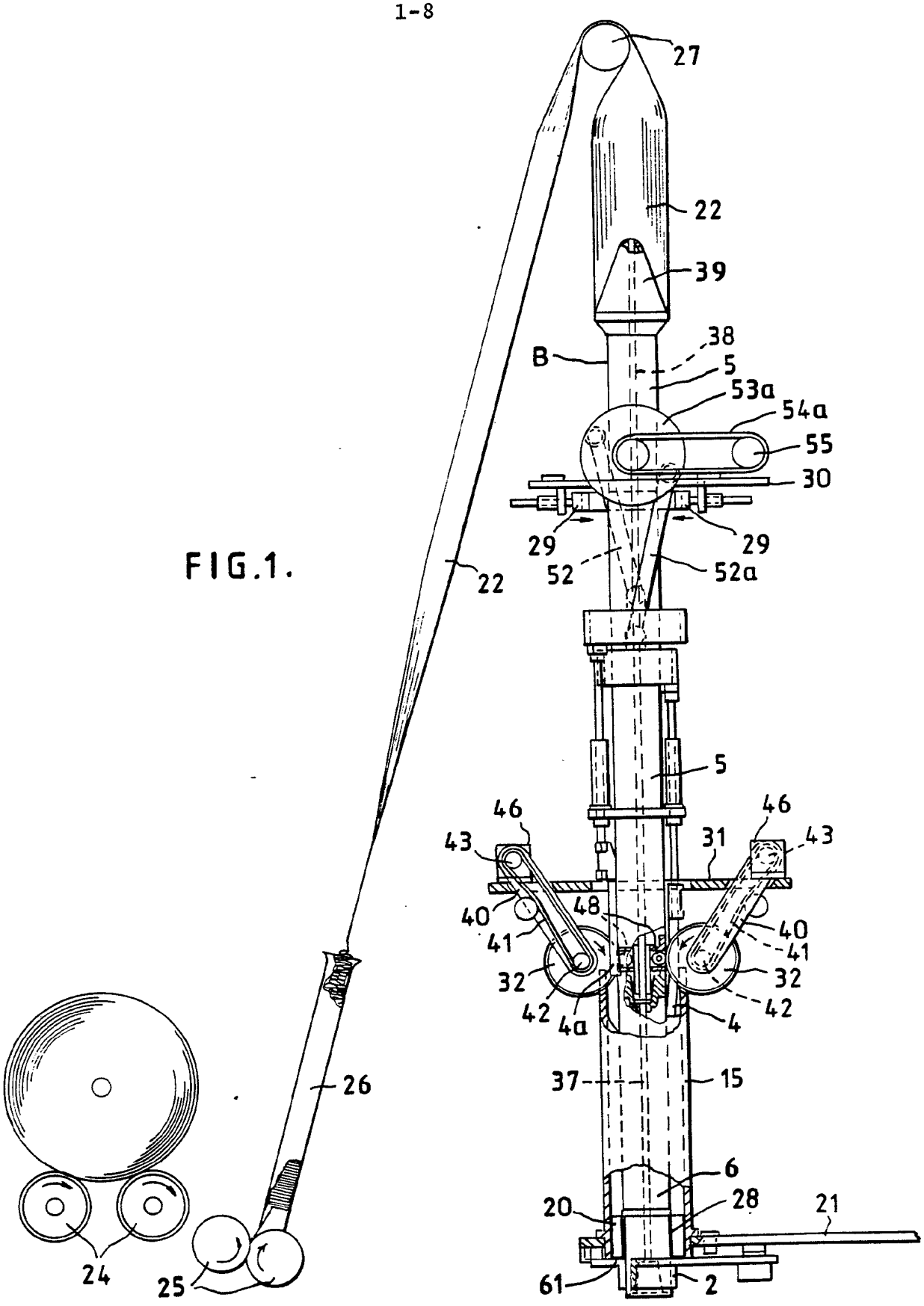
At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

FIG.1.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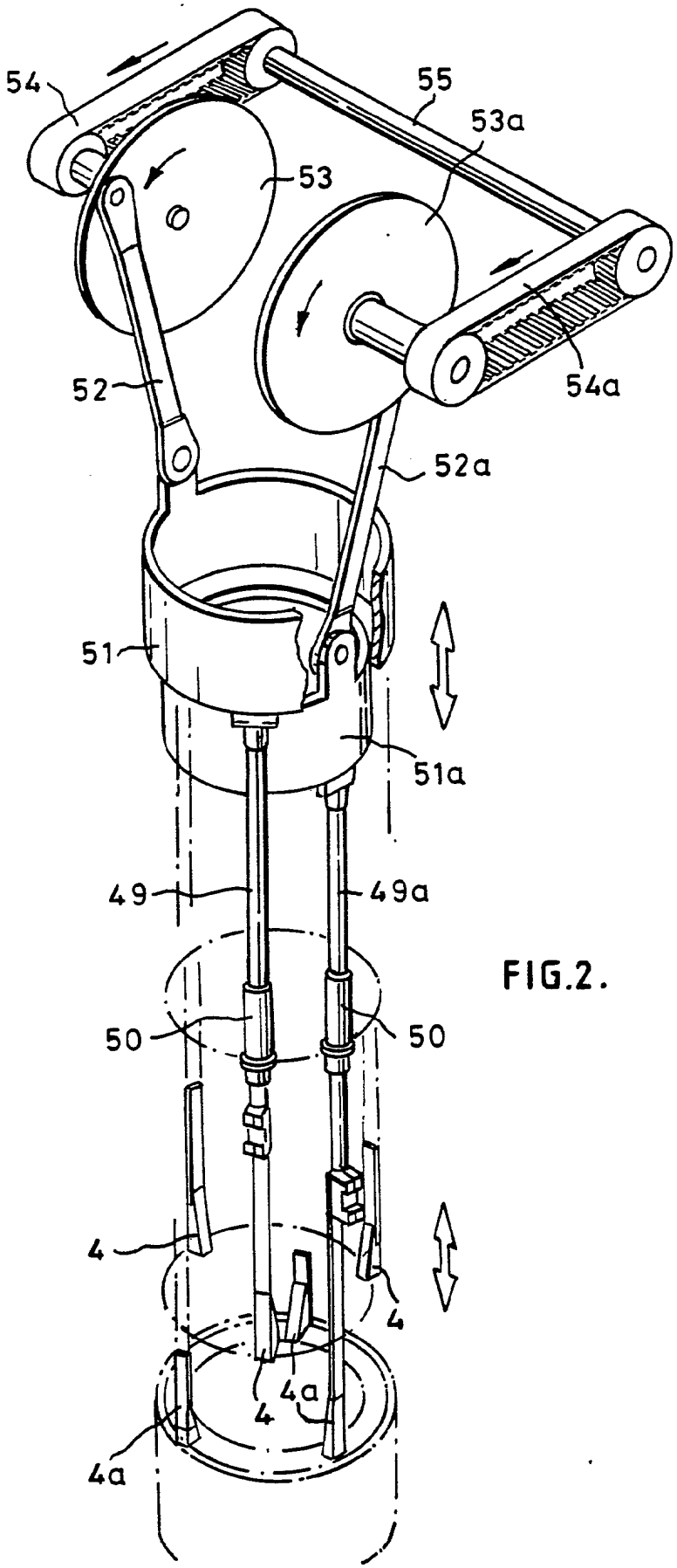


FIG.2.

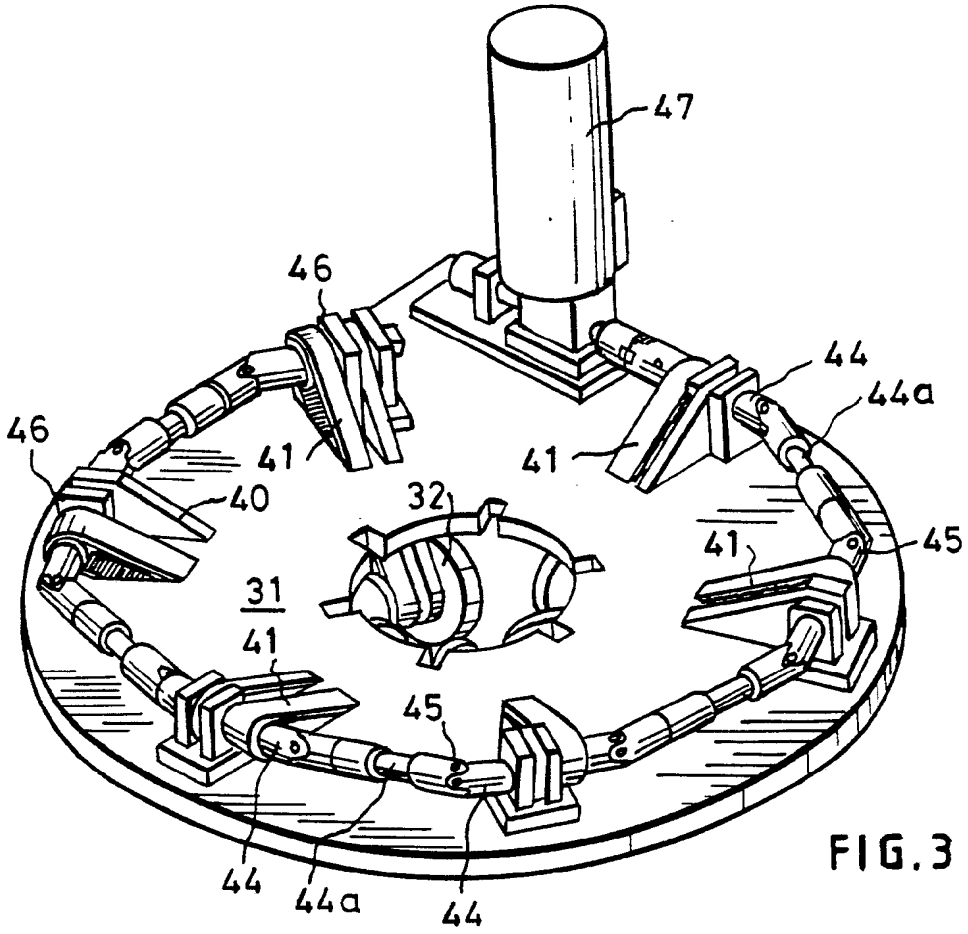


FIG.3.

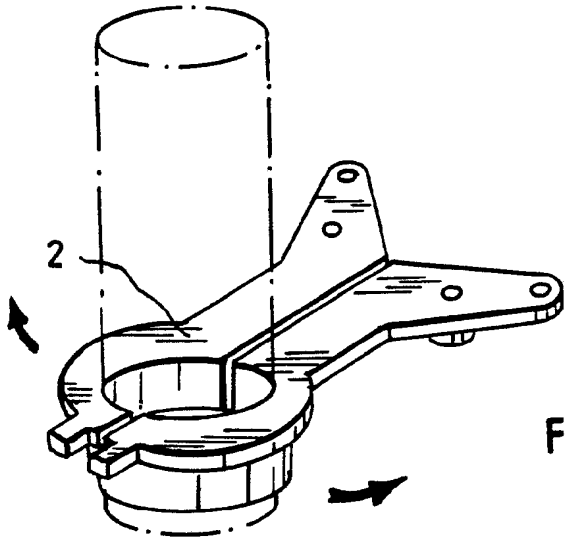
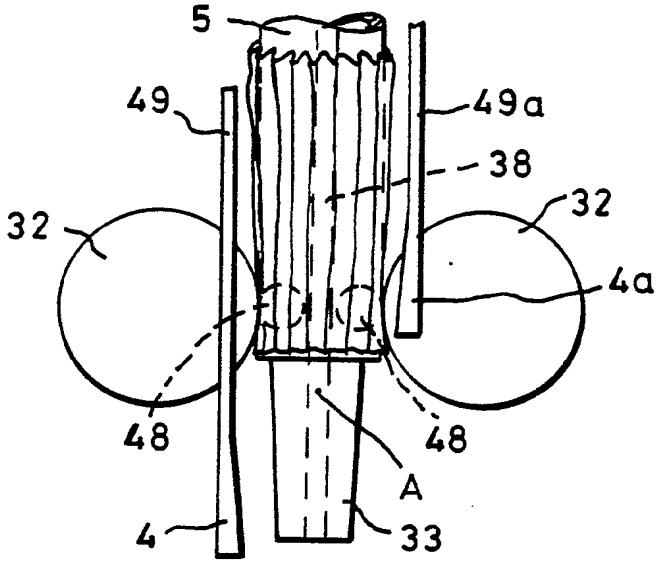


FIG.4.



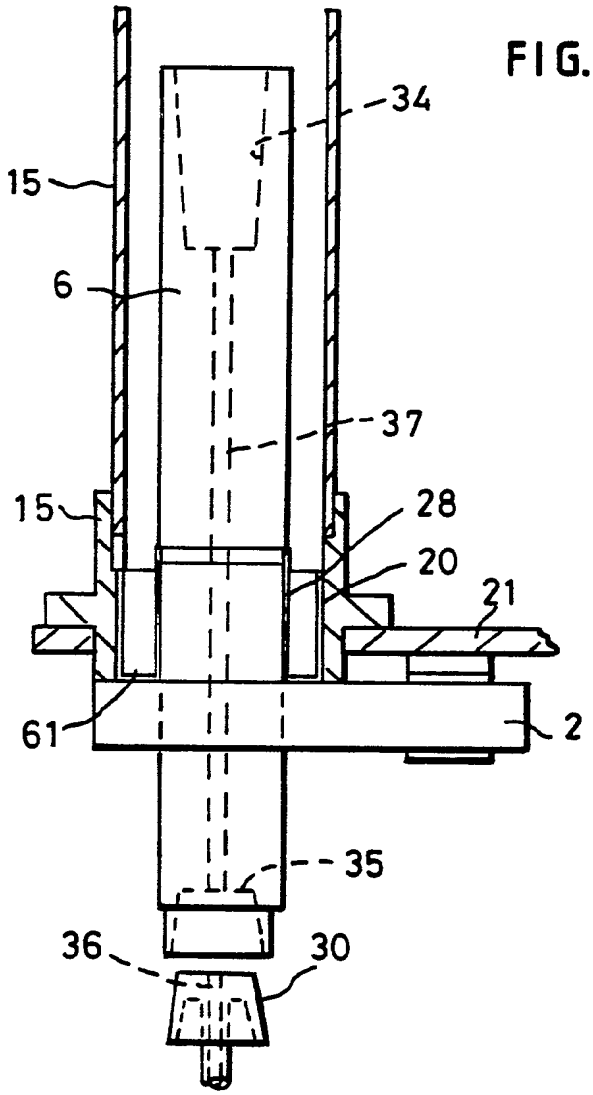


FIG.5.

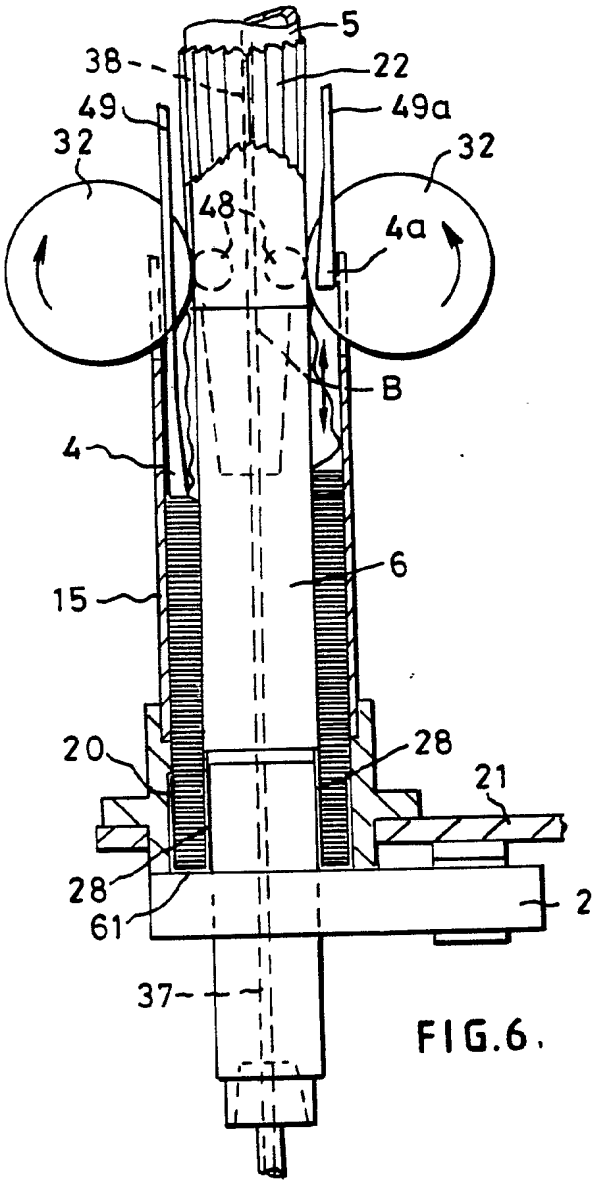


FIG.6.

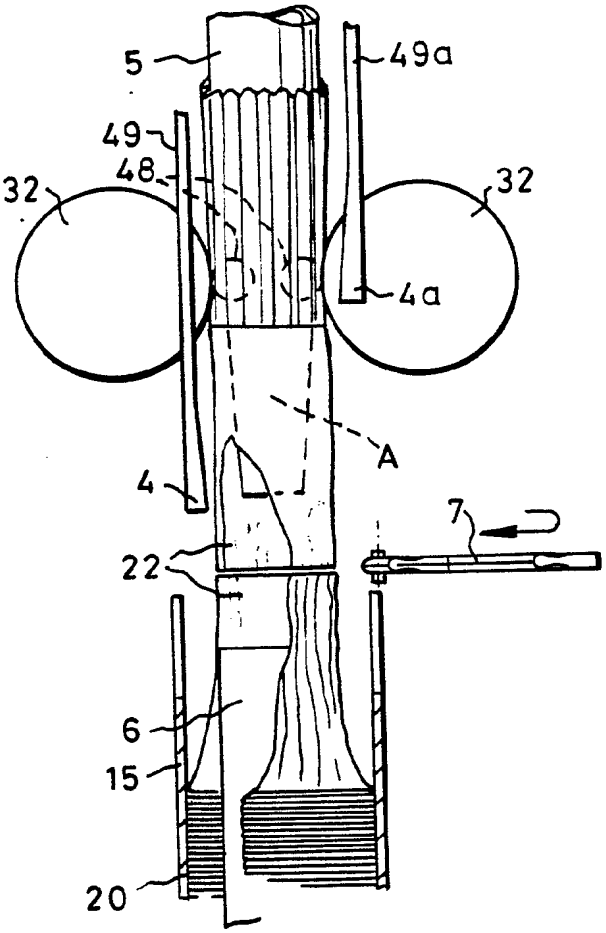


FIG.7.

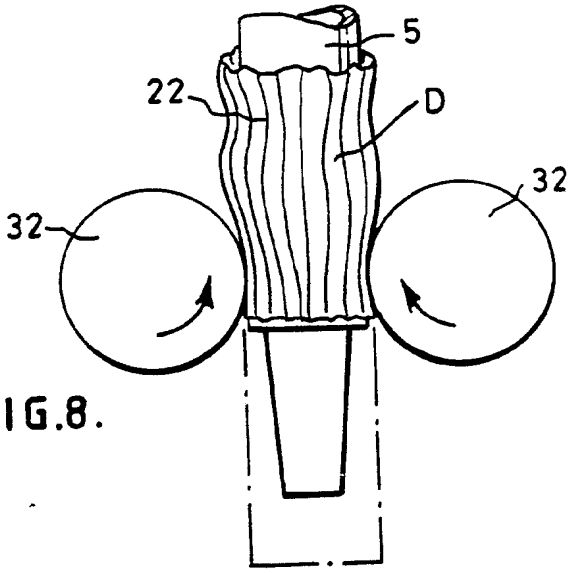


FIG.8.

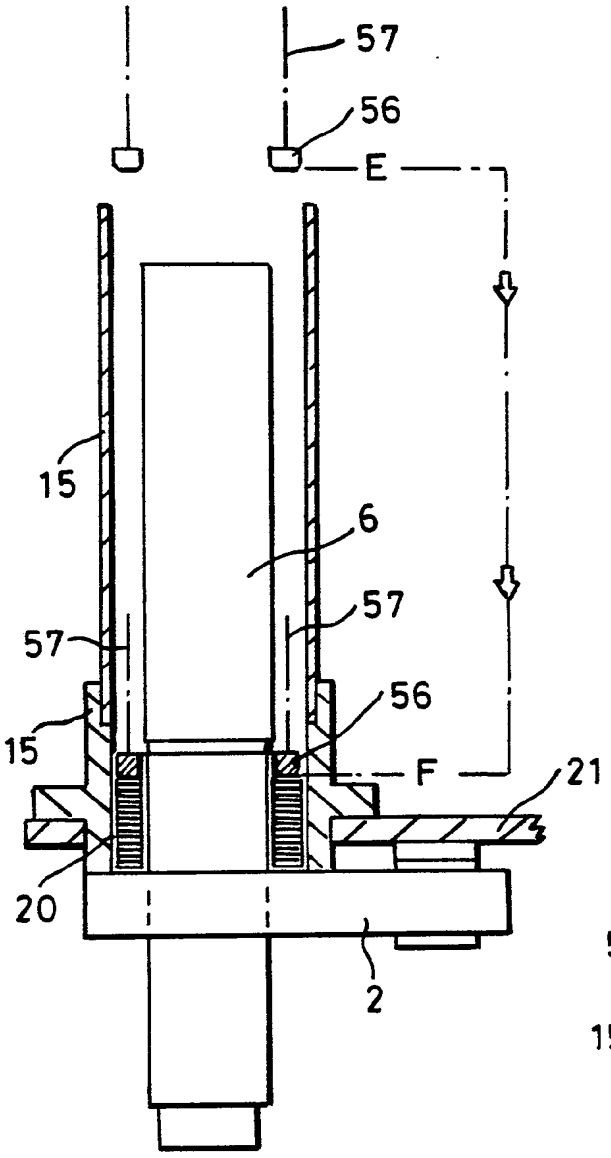


FIG.9.

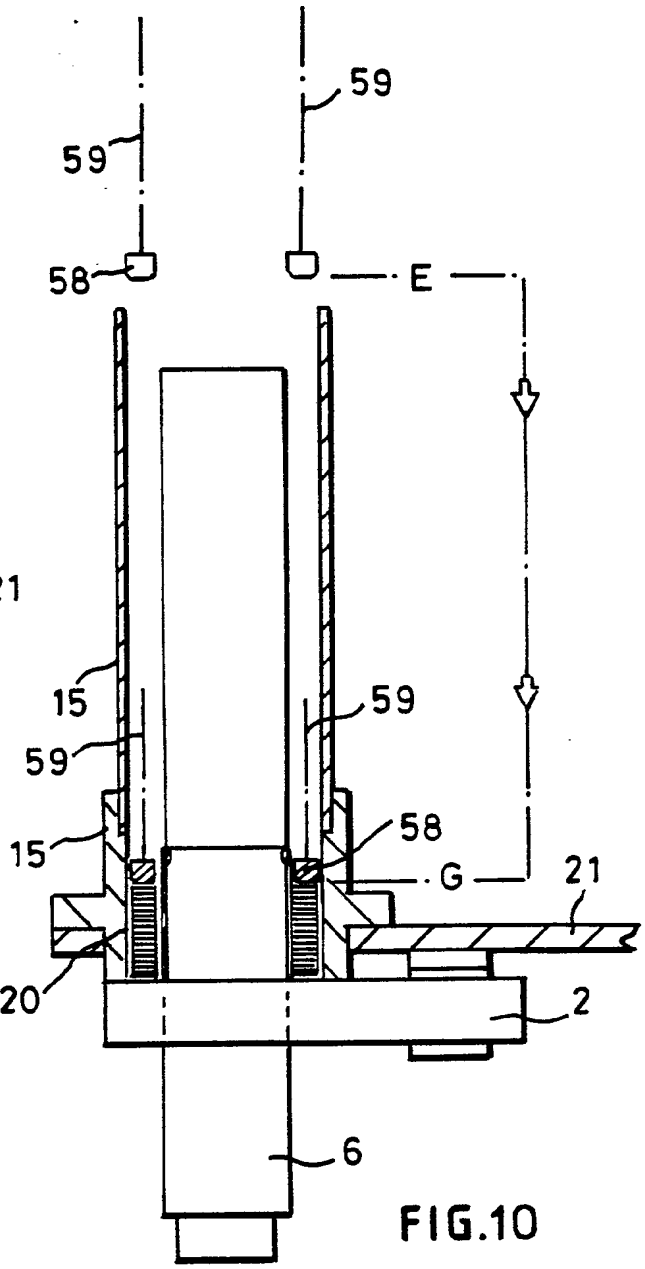


FIG.10

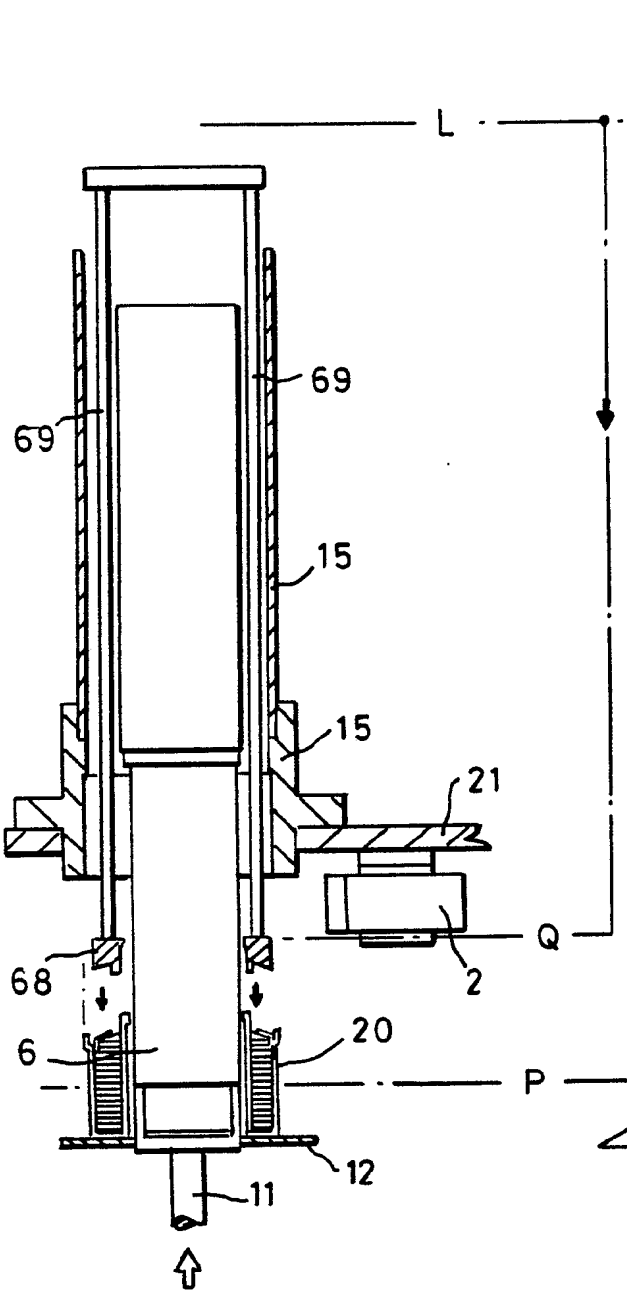


FIG.12.

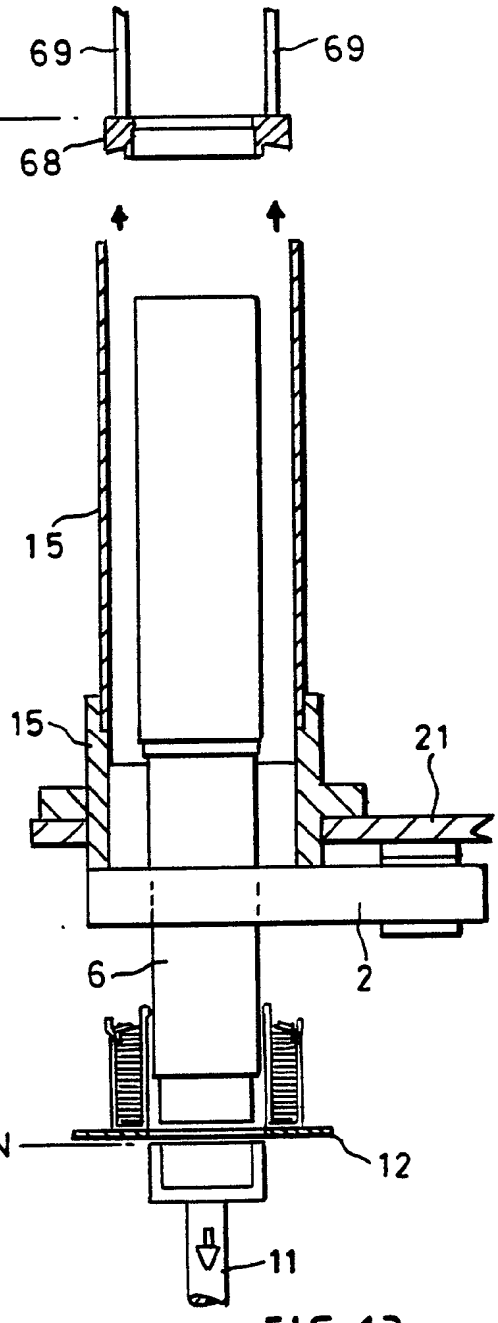


FIG.13.

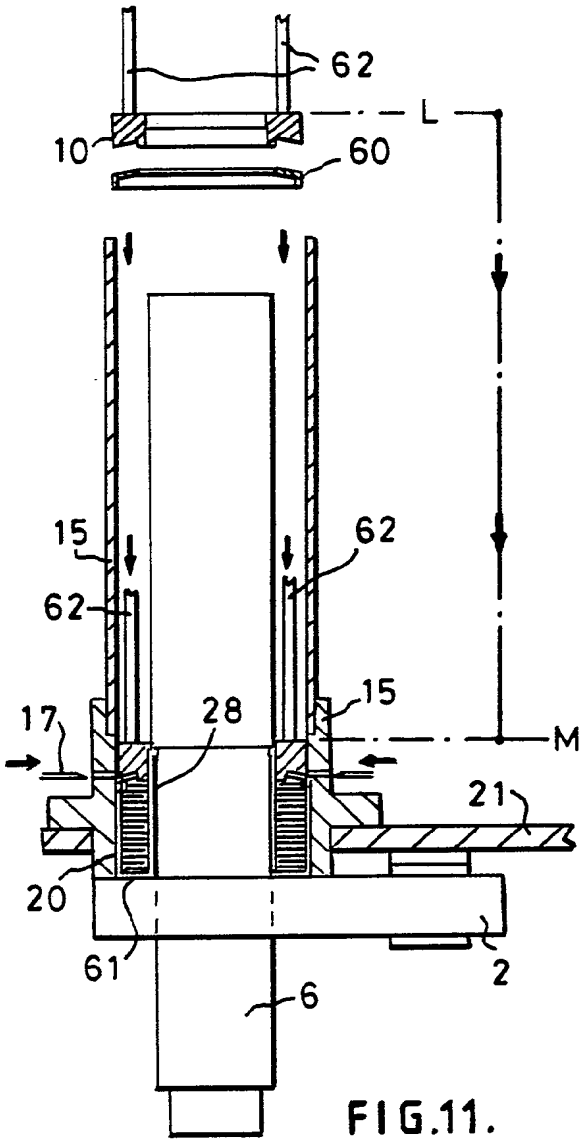


FIG.11.

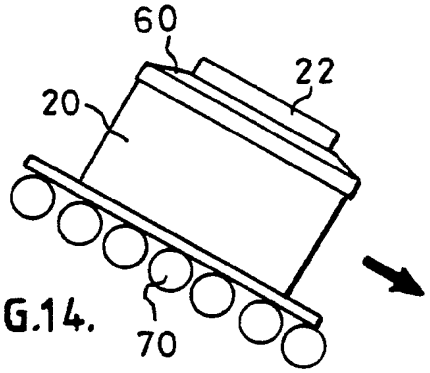


FIG.14.

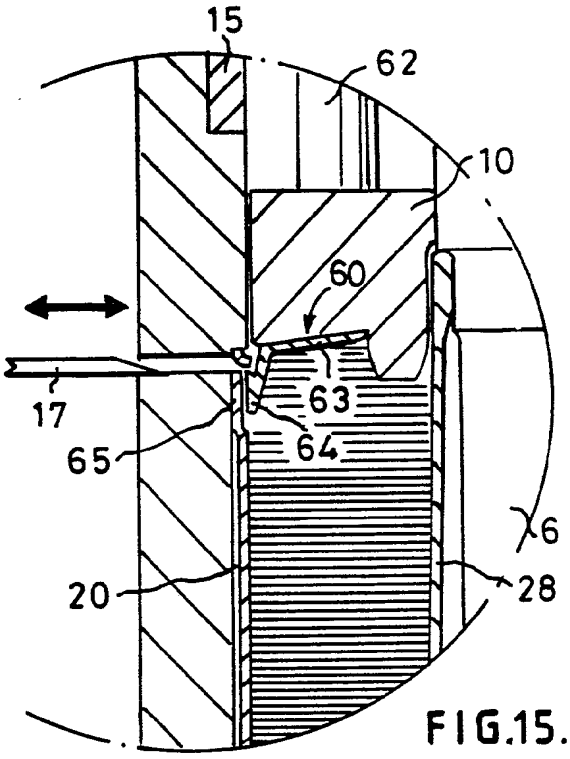


FIG.15.

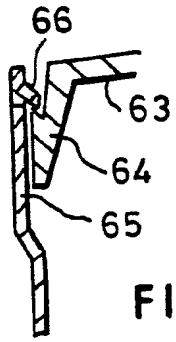


FIG.16.

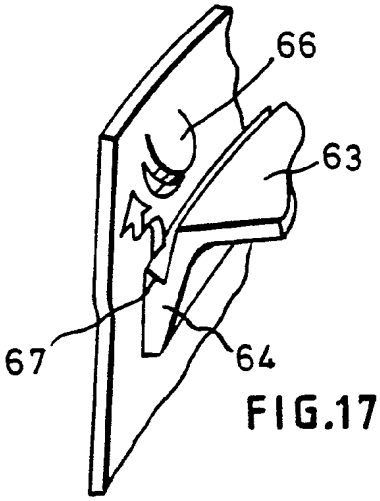


FIG.17.

APPARATUS FOR PRODUCING LAYERED TUBES OR RINGS

This invention relates to apparatus for producing in series layered or pleated tubes or rings each consisting of a comparatively very long length of flexible, non-resilient tubing compacted into a very much shorter tube or ring constituting a unit to be used elsewhere for a particular purpose. Such a purpose may be the dispensing of the tubing in the tube or ring pack for packaging a series of objects respectively in individual packages along a length of the dispensed tubing.

In European patent application No. EP-A-0281355 a device is described for use with a cassette containing a tube or ring pack as aforesaid to be dispensed for the disposal of waste.

An object of the present invention is to provide an apparatus for the production in series of such layered or pleated tubes or rings at an economically high speed.

According to the present invention, apparatus for producing in series layered or pleated tubes or rings from a length of flexible, non-resilient tubing comprises a layering tube for controlling the outside diameter of the tubes or rings as they are formed, a central mandrel mounted inside the layering tube for controlling the inside diameter of the tubes or rings as they are formed, means closing the annular passage between the layering tube and central mandrel at one end thereof, means for feeding flexible, non-resilient tubing having a diameter appreciably larger than that of the central mandrel into the other end of the said passage at a rate such that the tubing gathers in the passage, means arranged to reciprocate inside the said passage to compact the tubing into layers or pleats as it gathers towards the closed end of said passage, means for severing a portion of the tubing so compacted from a remaining portion of the tubing, and means enabling a layered or pleated tube or ring when so compacted to be discharged from said passage. Where the tubing is to be packed in a

container, such as the aforesaid cassette, an annular container may be mounted at the closed end of the said passage to receive the layered or pleated tube or ring as it is being formed and then to be discharged therewith. The container then has an outer wall contacting the inside surface of the layering tube and a tubular core fitting the central mandrel.

Very advantageously the layering tube and central mandrel may be mounted on a turntable arranged to be indexed round through a series of further stationary positions at which the layered tube or ring can be subjected to further treatment such as the closing of an annular container with a lid to form a cassette as aforesaid and the discharge of the cassette from the apparatus.

In order that the invention may be clearly understood and readily carried into effect an apparatus for gathering lengths of flexible tubular material into series of layered tubes or rings thereof will now be described, by way of example, with reference to the accompanying drawings, in which:-

Fig. 1 is an elevation, shown partly in section, of mechanism for packing flexible tubular material into individual annular containers;

Figs. 2, 3 and 4 are perspective views showing various details of the mechanism of Fig. 1;

Figs. 5 through 8 are diagrams showing a series of phases on the operation of the mechanism of Figs. 1 through 4;

Figs. 9 through 14 are diagrams showing a series of phases in the operation of mechanisms associated with the mechanism of Figs. 1 through 4; and

Figs. 15 through 17 show details associated with Fig. 11.

The mechanism of Fig. 1 is provided for effecting a basic phase in packing a mass of profusely and tightly layered non-resilient tubing in a container constituting the body 20 of a cassette as particularly described in

applicant's co-pending British Patent Application No. 8818365.2. Such cassettes are fed in sequence on a turntable 21 in steps through six stations equidistantly spaced round the axis of the turntable. The mechanism of Fig. 1 may be regarded as located at station I, the body 20 having previously been located at station VI (not shown in drawings) in the position shown on the turntable 21.

The tubing 22, which may be high density polyethylene tubing having a 12 micron wall thickness and 6 inches (15.24 cm) diameter corresponding to the outer diameter of the annular space shown in the body 20. However, it will be appreciated that the invention can be adapted to a wide variety of types of tubing and dimensions. The tubing is derived from a roll 23 thereof resting on rollers 24. Pinch rollers 25 are arranged to withdraw the tubing and thrust it into a reservoir container 26 to provide an amorphous reservoir from which the tubing can be drawn upwards to pass over a roller guide 27 prior to travelling over a floating mandrel 5 and a central mandrel 6 to be layered in a layering tube 15 for packing into the body 20.

Each of the six positions on the turntable is furnished with a layering tube 15 and with a central mandrel 6 which has an appropriately smaller diameter than the tubing 22 and which can slide vertically in the turntable but, for example at station I, is held fixed on the turntable by a split clamp 2 (see also Fig. 4) having pivoted jaws. The floating mandrel 5, however, is unique to station I. As shown in Figs. 1, 5 and 6, the cassette body 20 has a central tubular core 28 that fits on the central mandrel 6. The core 28 is joined to the body 20 by an annular base wall 61. The internal diameter of the core is 4 inches (10.16 cm) and the diameter of the body 20 is approximately 6 inches (15.24 cm).

At the beginning of a cycle of operations the floating mandrel 5 is in the raised position A shown in Fig. 5, being clamped in that position by pneumatically

actuated clamps 29 (Fig. 1) which also clamp the tubing on the mandrel 5. These clamps 29 are mounted on a platform 30 which is then operated to lower the floating mandrel 5 to the position B of Figs 1 and 6. Simultaneously a mounting plate 31 carrying drive rollers 32 (described below) is lowered to carry the rollers 22 to the position of Fig. 6. A tapered lower end 33 of the floating mandrel 5 is consequently located in a tapered recess 34 in the central mandrel 6 and an air supply 30 is simultaneously inserted into a recess 35 at the bottom of the central mandrel 6. This member 30, the central mandrel 6, and the floating mandrel 5 are formed with axial passages 36, 37, 38 respectively leading to the top end of a deblocking cone 39 at the top of the floating mandrel to enable a supply of compressed air to form an air bubble in the tubing above the cone to facilitate the passage of the tubing over the cone when being fed towards the body 20.

This feeding forward of the tubing 22 is effected, after the clamps 29 have been withdrawn, by the drive rollers 32. There are six of these rubber covered drive rollers mounted on horizontal axes, located at the ends of arms 40 equidistantly distributed round the floating mandrel. Each drive roller 32 is driven by its own individual belt 41 between spools 42, 43 on the drive roller and an associated one of six shafts 44 connected together by intervening shafts 44a and universal joints 45 to form a ring carried in bearings 46 on the mounting plate 31. An electric motor 47 drives the shafts 44 about their respective axes. Each drive roller 32 engages a respective one of six pinch rollers 48 mounted in the floating mandrel freely to rotate therein with the tubing material intervening between the engaging drive rollers and the pinch rollers. Thus, the drive rollers in feed the tubing forward to become layered between the central mandrel 6 and the layering tube 15.

As the tubing is being delivered into the layering tube 15 it is cleared away from the drive rollers 32 and

compacted by two sets of three compacting shoes 4, 4a inter-digitated about the floating mandrel 5. The groups of shoes 4, 4a are carried by stems 49, 49a guided by sleeves 50 and connected to rings 51, 51a respectively connected by connecting rods 52, 52a to crank pins on discs 53, 53a rotated through belts 54, 54a by a power driven shaft 55, the shaft 55 being electrically driven. The crank pins are 180° out of phase so that the groups of shoes 4, 4a compress the pleated tubing alternately.

When the required tubing length has been accommodated the feed rollers 36 are stopped as also are the discs 53, 53a. The clamps 29 are then caused once more to engage the floating mandrel with the tubing 22 intervening and the platform 30 and mounting plate 31 are raised to return the floating mandrel 5 to the position A (Figure 7). A hot wire 7 is then carried horizontally through the tubing to sever it between the floating mandrel 5 and central mandrel 6. Reverse rotation is then applied to the feed rollers 36 to withdraw the tubing 22 back to position D (Figure 8).

The turntable is now indexed to carry the cassette body 20 to station II (Figure 9). At this station a vertically reciprocable compression ring 56 carried by vertical rods 57 is traversed from position E to position F inside the body 20 to compress the layered tubing inside the body. The ring 56 is then raised again to position E to allow the turntable to be indexed so as to carry the cassette body to station III (Fig. 10).

At station III a compression ring 58 carried by vertical rods 59 is traversed from position E to position G inside the body 20 further to compress the layered tubing inside the body 20.

The cycle times of the movements of the rings 56 and 58 at stations II and III are the same as the cycle time of the operation of the mechanism at station I. This enables the rings comparatively gradually to compress the layered tubing in the body while any air trapped between the tubing layers escapes round the edges of the rings,

clearance between the rings and body 20 and core 28 being provided for this.

The turntable is now indexed to carry the body 20 to station IV (Fig. 11) where an annular cap 60 is mounted over the cassette body 20. The cap 60 as well as the body 20 with its core 28 and base wall 61 are moulded from plastics material. The cap 60 is transferred from a stack J to a location shown at the top of Fig. 11 between the top of the layering tube 15 and a placing ring 10 carried by vertically reciprocable rods 62 that force the placing ring 10 down between positions L and M to locate the cap 60 over the layered tubing between the body 20 and core 28 (see particularly Fig. 15). The cap 60 has an annular top 63 and a peripheral flange 64 which is a sliding fit inside the layering tube 15 and inside a slightly expanded portion 65 of the body 20 at the top thereof. This avoids any possibility of any tubing being trapped when the cap 60 enters the body 20. The cap presses the pleated part of the tubing slightly further so that, in order to retain the cap 60 in the body 20, three horizontally reciprocable piercing tools 17 equidistantly spaced round the body 20 can be operated simultaneously to force tabs 66 out of the body wall to engage a peripheral notch 67 round the periphery of the flange 64. The placing ring 10 retains the cap 60 sufficiently depressed for the tabs 66 to be formed before the placing ring is returned to position L. Clearance is provided between the top 63 of the cap and the cassette core 28 to enable the tubing to be drawn out of the cassette when the cassette is in use. Alternatively small projections may be formed in the body wall as initially constructed the projections being distributed around the body wall at a uniform height and projecting slightly inwards therefrom. Then the placing ring is used simply to snap the edge of the cap into position beneath the projections.

The turntable 21 is now indexed from station IV to station V (Figs. 12 and 13) where the completed cassette

is removed from the apparatus. For this purpose a support 11 is raised from position N to position P to support the central mandrel 6 before it has been released by the clamp 2. The withdrawal of the clamp 2 leaves the way clear for a pushing ring 68 on descending rods 69 to travel from position L to position Q transferring the cassette to a position where it falls away from the pushing ring 68 on to a platform 12. The pushing ring then returns to position L, the clamp 2 clamps the central mandrel 6 again and the support 11 goes back to position N. The way is then clear for the turntable 21 to carry the layering tube 15 and central mandrel 6 to station VI to receive another cassette body 20.

In the movement from station V to station VI the lower end of the central mandrel 6 carries the completed cassette to a position in which it falls from the platform 12 onto a conveyor 70 (Fig. 18).

It will be clear that various methods may be adopted for mounting the next cassette body between the central mandrel 6 and layering tube 15 at station VI (not shown in the drawings). For example the new body 20 can be transferred from a stack thereof to surround a location boss reciprocable towards and away from the bottom of the central mandrel 6. This boss contacts the mandrel while a top support contacts the top of this mandrel so that the mandrel is held against axial movement when the clamp 2 is opened. Thrust rods can then lift the body from the location boss to its location above the clamp 2 which can then be closed to hold the central mandrel again, the clamp being shaped to allow the thrust rods to descend from the turntable.

It has been found that the apparatus described above can pack 100 feet (30.48m) of tubing in a cassette within 15 seconds and three loaded closed cassettes can be produced in one minute. It is thought that with improved driving machinery these speeds can be exceeded. Mechanical, electrical, pneumatic or hydraulic driving means for the step-by-step or reciprocating movements of

the parts requiring such movement in timed relationship can readily be designed by those skilled in the art so that such means are not described in this specification.

Various modifications of the mechanisms described above are possible without departing from the scope of the following claims. For example the layered packs of tubing can be formed between the central mandrel 6 and layering tube 15 without any intervening container such as the cassette body 20. Each pleated pack can then be removed downwards between a pair of reciprocable rings, after the clamp 2 has been opened, the pack being carried to a point where it can be bound, clipped or encased for removal to the point where it is required.

It will be understood that the layering tube need not be a simple imperforate tube but may have apertures therein or it may be constituted by a plurality of parts such as parallel rods arranged to define a tubular envelope surrounding the layered or pleated tubing.

CLAIMS:

1. Apparatus for producing in series layered or pleated tubes or rings from a length of flexible, non-resilient tubing the apparatus comprising a layering tube for controlling the outside diameter of the tubes or rings as they are formed, a central mandrel mounted inside the layering tube for controlling the inside diameter of the tubes or rings as they are formed, means closing the annular passage between the layering tube and central mandrel at one end thereof, means for feeding flexible, non-resilient tubing having a diameter appreciably larger than of the central mandrel into the other end of the said passage at a rate such that the tubing gathers in the passage, means arranged to reciprocate inside the said passage to compact the tubing into layers or pleats as it gathers towards the closed end of said passage, means for severing a portion of the tubing so compacted from a remaining portion of the tubing, and means enabling a layered or pleated tube or ring when so compacted to be discharged from said passage.

2. Apparatus according to Claim 1, arranged for an annular container to be mounted in the said passage to receive the layered or pleated tube or ring as it is being formed and then to be discharged therewith, the container having an outer wall contacting the inside surface of the layering tube and a tubular core fitting the central mandrel.

3. Apparatus according to Claim 1 or Claim 2, in which a floating mandrel is mounted coaxially with the central mandrel for movement between a postion in which it constitutes a continuation of the cental mandrel and a separated position in which it permits the operation of the severing means between the two mandrels, power driven means being mounted on the floating mandrel for feeding the tubing over the floating mandrel and the central mandrel from a source of such tubing.

4. Apparatus according to Claim 3, in which the power

driven means comprise drive rollers distributed round the floating mandrel and engaging pinch rollers mounted to rotate in the mandrel for feeding the tubing along the floating mandrel between the drive rollers and the pinch rollers.

5. Apparatus according to Claim 3 or Claim 4, in which the severing means is a hot wire arranged to travel between the floating mandrel and the central mandrel when separated.

6. Apparatus according to any one of Claims 3 to 5, arranged for the tubing to be withdrawn from a roll of flattened tubing, the central mandrel and floating mandrel being formed with axial passages for the supply of compressed air therealong when the mandrels are in contact to the end of the floating mandrel where the tubing is received to produce an air bubble in the tubing as it approaches the said end, the latter being shaped to fill the cross-sectional area of the tubing.

7. Apparatus according to any one of the preceding claims, arranged for the tubing to be supplied from a roll of flattened tubing, power driven rollers being provided for maintaining an amorphous mass of the tubing in a reservoir and the feeding means being arranged to withdraw the tubing from the reservoir.

8. Apparatus according to any one of the preceding claims, in which the means for reciprocating inside the layering tube for compacting the tubing into layers or pleats comprises a plurality of shoes carried at the ends of stems arranged to be reciprocated longitudinally by means beyond the layering tube.

9. Apparatus according to Claim 8, in which there are two sets of interdigitated stems and shoes, means being provided for reciprocating the two sets out of phase with one another.

10. Apparatus according to Claim 9 and any one of Claims 3 to 7, in which the two sets of stems and shoes are carried respectively by two rings encircling the floating mandrel and aranged to be reciprocated by

mechanism mounted to move with the floating mandrel.

11. Apparatus according to any one of the preceding claims, in which the layering tube and central mandrel are mounted on a turntable that can be indexed round through a series of further stationary positions at which each of the layered tubes or rings can be subjected to further treatment.

12. Apparatus according to Claim 11, in which at least one of the further positions is associated with a pressure ring arranged further to compress the tube or ring and then to be withdrawn.

13. Apparatus according to Claim 11 or Claim 12, in which at one of the further positions means are provided for pressing a lid on an open annular container containing the layered or pleated tube or ring and latching the lid to the container.

14. Apparatus according to any one of Claims 11 to 13, in which one of the further positions is associated with means for opening the closing means at the end of the annular passage between the layering tube and central mandrel and for ejecting the layered tube or ring out of the passage.

15. Apparatus for producing in series layered or pleated tubes or rings from a length of flexible, non-resilient tubing substantially as hereinbefore described with reference to the accompanying drawings.

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